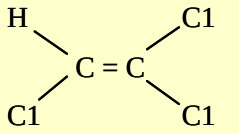
Trichloroethylene

Symbol: **C_2HCl_3**



Molecular Weight: 131

What Is It? Trichloroethylene, C_2HCl_3, is a nonflammable, colorless liquid with a sweet odor. This man-made chemical is also known as trichloroethene and is often called TCE. When left exposed to air, it enters the atmosphere as a gas, with a half-life of about a week. (The chemical half-life is the time it takes half the initial amount to be broken down.) It decomposes to form phosgene and hydrogen chloride. Trichloroethylene is moderately soluble in water. Most people can smell trichloroethylene in the air at concentrations of about 100 parts per million (ppm).

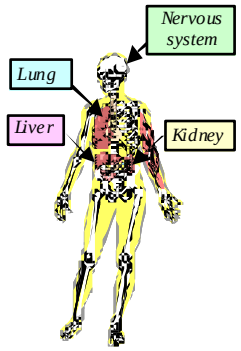
How Is It Used? Trichloroethylene is an industrial solvent used primarily in metal degreasing and cleaning operations at facilities such as the Hanford Site. It is commonly used to remove grease from metal parts manufactured for use in making automobiles. It is also used to make other chemicals such as polyvinyl chloride, varnishes, adhesives, paints, and lacquers. Trichloroethylene is present in many household products, such as spot removers, carpet cleaning fluids, typewriter correction fluids, and paint removers. It was once used as a dry-cleaning solvent, fumigant, and general anesthetic, but these uses have been discontinued. Before 1977, it was used to remove caffeine from coffee beans. About 200 million pounds of trichloroethylene are used every year in the United States.

What's in the Environment? Trichloroethylene is present mainly in air and water. It evaporates easily from surface water but can stay in subsurface soil and groundwater for a long time. The largest source of trichloroethylene in air is evaporation from factories that use it for removing grease from metals. Although it is rapidly broken down in air, it is used in such large amounts that it continuously enters the atmosphere and has been found in air throughout the world. In the United States, the average concentration in air ranges from about 30 to 460 parts per trillion (ppt), with the higher averages occurring in urban and industrial areas. Trichloroethylene in soil and groundwater can be broken down by bacteria, forming vinylidene chloride (a suspected human carcinogen) and vinyl chloride (a known human carcinogen). According to a study by the Environmental Protection Agency (EPA), up to 34% of the drinking water sources in the United States contain trichloroethylene. In soil, the concentration of trichloroethylene associated with the soil particles has been estimated to be about 60% of that in interstitial water (in pore spaces between soil particles). The median concentration in water from groundwater sources is around 0.3 parts per billion (ppb). Trichloroethylene has also been found at very low levels in various prepared foods. It does not build up to significant levels in plants, animals, or fish.

What Happens to It in the Body? Trichloroethylene can enter the body by breathing air, drinking water, and eating food containing the chemical, and it can also be absorbed through the skin. When trichloroethylene is inhaled, up to 75% may be retained in the body. A large amount is also retained when ingested. Some trichloroethylene is stored in fatty tissue and the rest remains in the blood and circulates through the body. However, the chemical is rapidly metabolized to dichloroacetic acid, trichloroacetic acid, trichloroethanol, and other chemicals, most of which leave the body in the urine.

What Are the Primary Health Effects? Exposure to trichloroethylene can result in toxicity to a number of organs and systems, including the nervous system, liver, kidney, blood, cardiovascular system, immune system, and reproductive system. Exposure to high concentrations of trichloroethylene in air or water for a short period of time affects mainly the central nervous system. Breathing air or drinking water with very high concentrations of trichloroethylene can cause a person to lose consciousness and can result in death. At somewhat lower concentrations, people may become sleepy or dizzy and get headaches.

Except in severe cases, the effects disappear after exposure stops. Exposure to relatively low levels of trichloroethylene in air or water for a long period of time (years) can damage the liver and kidney. Effects on the liver and kidney are more severe in people with impaired liver or kidney function, such as alcoholics. Abnormal development of the skeleton and other effects have been observed in the offspring of animals exposed to trichloroethylene; however, it is not known if similar effects can occur in humans. Skin contact with trichloroethylene can cause rashes. Trichloroethylene has been shown to cause cancer in animals, but we do not know if it causes cancer in humans. The International Agency for Research on Cancer has determined that trichloroethylene is not classifiable as to human carcinogenicity, and the EPA is currently reviewing its carcinogenicity.



Organs and systems affected when TCE is taken in with food, water, or air.

What Is the Risk? The EPA has developed toxicity values to estimate the risk of getting cancer or other adverse health effects as a result of inhaling or ingesting trichloroethylene. At this time, only provisional or withdrawn values are available from the EPA. The toxicity value for estimating the risk of getting cancer is called a slope factor (SF), and the value for the non-cancer effect is called a reference dose (RfD). An SF is an estimate of the chance that a person exposed to the chemical will get cancer from taking in one milligram per kilogram of body weight per day (mg/kg-day), for a lifetime. An RfD is an estimate of the highest dose that can be taken in every day without causing an adverse non-cancer effect. These toxicity values have been developed by studying test animals given relatively high doses over their lifetimes, then adjusting and normalizing those results to a mg/kg-day basis for humans.

To illustrate how the RfD is applied, a 150-pound (lb) person could safely ingest 0.4 milligrams (mg) every day without expecting any adverse effects (2.2 lb = 1 kg, or 1,000 g). In contrast to the RfD, which represents a "safe daily dose" (and so is compared to the amount an individual takes in, as a ratio), the SF is multiplied by the amount taken in to estimate the cancer risk. Using these toxicity values, the EPA estimates that a person would have a one-in-a-million chance of developing cancer if they drank about two quarts of water containing 3 micrograms per liter (µg/L) or inhaled air containing about 0.6 microgram per cubic meter (µg/m^3) of trichloroethylene every day for 30 years or more.

Chemical Toxicity Values		
Cancer Risk		**Non-Cancer Effect**
Oral SF	***Inhalation SF***	***Oral RfD***
0.011 per mg/kg-day	0.006 per mg/kg-day	0.006 mg/kg-day
The RfD for inhaling trichloroethylene has been taken to be the same as that developed for ingestion.		

What Are Current Limits for Environmental Releases and Human Exposures? To help track facility releases to the environment, the Superfund amendments that address emergency planning and community right-to-know require releases of trichloroethylene to air, water, or land to be reported annually and entered into a nationwide Toxic Release Inventory. Releases above 100 lb (45.4 kg) are to be immediately reported. For drinking water supplies, the EPA has established a protective level (maximum contaminant level) of 5 ppb and has established a goal of zero. For air in the workplace, the Occupational Safety and Health Administration has identified a limit of 100 ppm for an 8-hour work day over a 40-hour work week.

Where Can I Find More Information? More information on trichloroethylene can be found in the primary information source used to prepare this overview: the Toxicological Profile for Trichloroethylene prepared by the Agency for Toxic Substances and Disease Registry. Several sources of information are available on the Internet, including the ATSDR ToxFAQS (http://www.atsdr.cdc.gov/toxfaq.html), the EPA's Integrated Risk Information System (http://www.epa.gov/iris/subst/index.html), and the National Library of Medicine Hazardous Substances Data Bank (http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB).